

Mississippi Maternal Mortality Report

2013 - 2016

Mississippi State Department of Health

April 2019

(Addended March 2021)

Contents

Committee Members	3
Acknowledgements	4
Executive Summary	5
Introduction	6
Definitions	7
Identification of Deaths & Record Abstraction.....	8
Review and Evaluation.....	8
Overview of Pregnancy Associated and Related Deaths.....	10
Causes of Pregnancy-Associated Deaths.....	11
Maternal Race.....	12
Maternal Age.....	13
Timing, Location and Pregnancy Outcome	14
Descriptions of Leading Causes of Pregnancy-Associated Deaths.....	15
Cardiovascular Conditions & Cardiomyopathy	16
Hypertension, Preeclampsia, Stroke	17
Thrombotic Pulmonary Embolism	18
Infectious Causes	19
Cancer	19
Psychosocial Causes.....	20
Motor Vehicle Crashes.....	21
Opportunities for Prevention.....	22
Committee Recommendations	23
Recommendations for State Leaders	23
Recommendations for Hospitals	23
Recommendations for Medical Providers	24
Recommendations for Women, Families & Communities	24
Conclusion	25
Resources.....	26
References.....	27

Maternal Mortality Review Committee Members

Authors: Charlene Collier MD, MPH, MHS, Mina Qobadi PhD, Tommy Cobb, MD, James N. Martin Jr. MD

Review Committee (2017)

Charlene Collier, MD, MPH, MHS, FACOG

Co-Chair, Director

*Associate Professor of Obstetrics & Gynecology,
University of Mississippi Medical Center
Mississippi State Department of Health*

James N. Martin Jr, MD, FACOG

Maternal Fetal Medicine

*University of Mississippi Medical Center
Co-Chair*

Myrna Alexander, MD, FACC

*Associate Professor, Division of Cardiovascular
Disease, University of Mississippi Medical Center*

Sarah J. Broom, MD

Pulmonary Medicine/Critical Care

*Past Medical Director, Blue Cross & Blue Shield of
Mississippi*

C. Shannon Carroll, DO, FACOG

*MS Section Chair, American College of Obstetricians
and Gynecologists, Jackson Healthcare for Women*

Tommy J. Cobb, MD, FACOG

Starkville Clinic for Women

Kate Fouquier PhD, RN, CNM, FACNM

*Associate Professor, University of Mississippi Medical
Center. School of Nursing,
American College of Nurse Midwives*

Arletha Howard, MSN, RN

*Tougaloo College/Delta Health Partners,
Healthy Start Initiative*

Krista Guynes, MSW, LCSW

*Social Services Director, Mississippi State Department
of Health*

C. LaToya Mason, MD, FASA

*Assoc. Prof. Anesthesiology,
University of Mississippi Medical Center*

Mississippi State Department Staff

Kathy Burk LCSW, CPM, Director, Health Services

Monica Stinson, MS, CHES, Bureau Director,
Maternal and Infant Health

Victoria Walker, MPH, Child Death Review
Coordinator

Yolanda Moore BSN, RN, LCCE

*Nurse Manager, Women's Urgent Care
University of Mississippi Medical Center*

Michelle Owens, MD, MS, FACOG

*Professor, Maternal Fetal Medicine,
University of Mississippi Medical Center*

Wesley Prater, MD

*Obstetric Consultant
Mississippi State Department of Health*

Kimberly Rickard MSN, RN-C OB

*President, MS Chapter Association of Women's
Health, Obstetric & Neonatal Nurses,
Nurse Manager, L&D, Baptist Memorial Hospital
Desoto*

Richard Rushing, MD, FACOG

Brookhaven OB/Gyn Associates

Susan Spencer RN-C OB

*Director of Nursing, Baptist Memorial Hospital- Golden
Triangle*

Wengora Thompson, MPH

*March of Dimes
Director, MCH & Government Affairs*

J. Martin Tucker, MD, FACOG

*Maternal Fetal Medicine
Secretary, American College of Obstetricians and
Gynecologists*

Jamie Szczepanski, MD, FACOG

Fellow, Maternal Fetal Medicine, UMMC

Alan E. Stallings Jr., MD

Anesthesiologist, Lakeland Anesthesia

Tony Wen, MD, FACOG

Section Chief, Maternal Fetal Medicine, UMMC

Dick Johnson, MS, Vital Statistics

Cynthia R. Street, RN, Nurse Abstractor

Geri McElroy CNM, NP, Nurse Abstractor

Hazel Gaines, MS, RN, Nurse Abstractor

Acknowledgements

The current Mississippi Maternal Mortality Review Committee (MMRC) was established with the support from the Centers for Disease Control and Prevention, Division of Reproductive Health's *Building US Capacity to Review and Prevent Maternal Deaths* program. We would like to thank Dr. Dave Goodman, Julie Zaharatos, Amy Zapata from the CDC for their technical assistance and support at every step of developing the MMRC. We would also like to acknowledge all of those involved in the passage of House Bill 494, which established the MMRC including MSDH legislative liaison Natalie Mahaffey, ACOG policy advocate Blake Bell, Representative Toby Barker, Senator Joey Filingane, House Public Health Committee Chairman Sam Mims and Senate Public Health Committee Chairman Dean Kirby.

This report is produced in remembrance of all women who have lost their lives during and after pregnancy and childbirth from any cause.

Correction Addendum 3/2021: The pregnancy-related mortality ratio was corrected for a calculation error to 33.2 deaths per 100,000 live births. The national pregnancy-related mortality ratio was updated since the time of the original publication of this report and updated within to reflect the data available from 2013 through 2016. Minor revisions were made for typographical and grammatical errors and for clarity.

Executive Summary

Maternal mortality is an important indicator of the quality of health and healthcare experienced by women. Each maternal death in Mississippi is an important loss affecting that mother's family, her community and our state. The Mississippi Maternal Mortality Review Committee is dedicated to reviewing maternal deaths in an effort to identify opportunities for improvement and make recommendations to prevent future maternal deaths. This report summarizes information on maternal deaths occurring between 2013 and 2016.

Key Findings

- In Mississippi between 2013 and 2016, there was a total of 136 maternal deaths occurring during pregnancy or within one year of the end pregnancy.
- The pregnancy-related mortality ratio was 33.2 deaths per 100,000 live births. This was 1.9 times higher than the average US ratio of 17.3 deaths per 100,000 live births.
- The pregnancy-related mortality ratio for Black women was 51.9 deaths per 100,000 live births, nearly three times the White ratio of 18.9.
- Cardiovascular conditions and hypertensive disorders of pregnancy were the two most common causes of pregnancy-related death in Mississippi.
- Suicides and overdoses accounted for approximately 11% of all maternal deaths.
- 86% of pregnancy-related deaths occurred postpartum, including 37% after 6 weeks.

Key Recommendations

For State Leaders

Given the number of postpartum deaths, extend Medicaid eligibility for the postpartum period from 60 days to one year after delivery. All health insurance plans should cover case management and outreach for postpartum high-risk women for up to one year after delivery.

Mississippi should increase access to mental health and substance use services statewide for pregnant and postpartum women.

For Hospitals

Implement comprehensive patient safety bundles for the management of severe hypertension, hemorrhage, and venous thromboembolism. Team based simulation training for obstetric emergencies is strongly advised.

All Emergency Departments should have training and emergency management protocols for common obstetric emergencies, particularly severe postpartum hypertension.

For Providers

Prepare to diagnose and manage cardiopulmonary conditions and complications in pregnant and postpartum women, particularly those presenting with shortness of breath. Support early (<4 week) and accessible follow-up for postpartum women, particularly those with high-risk factors like chronic hypertension, morbid obesity, preeclampsia, and depression.

For Mothers

Know the warning signs for obstetric complications including postpartum depression and make a follow up plan with medical providers for where to go and what to do if a postpartum complication arises.

Introduction

The Mississippi Maternal Mortality Review Committee (MMRC) was established in July of 2017 following passage of House Bill 494, which required the formal review of maternal deaths in Mississippi and secured protections for the confidentiality of the process. The MMRC was developed with guidance from the Centers for Disease Control and Prevention (CDC) Division of Reproductive Health's *Building US Capacity to Review and Prevent Maternal Deaths* program¹ and modeled after well-established review committees in the United States. The committee includes representation from a broad range of physicians and nurses from multiple specialties (Obstetrics & Gynecology, Cardiology, Pulmonary Medicine, Anesthesiology, Maternal-Fetal Medicine, Public Health) along with social workers, coroners, health advocates and other allied health professionals who extensively review maternal deaths in order to identify opportunities for prevention. As the goal of the review is identifying systems level changes and not individual blame, the names of patients, medical providers, and involved institutions are not disclosed to the committee members or included in this report.

This report provides a detailed description of how maternal deaths in Mississippi are identified, information is obtained and how each case is reviewed. Statistics and case examples are shared to provide a better understanding of the problem. Finally, there are recommendations presented for state leaders, hospitals, medical providers, and patients, families, and communities.

A pregnancy-related death is a tragedy of great magnitude. It is the hope of this Committee that by a process of analysis and education (of providers, institutions, patients and communities), that all women in Mississippi receive the optimal level of both care and compassion during and after pregnancy and that no woman dies from preventable pregnancy-related causes in our state.

Definitions

This report summarizes pregnancy-associated deaths that occurred in Mississippi between 2013 and 2016. Mississippi uses the definition for **pregnancy-associated death**, accepted by the CDC, Pregnancy Mortality Surveillance System (PMSS) which includes maternal deaths that occur during pregnancy and the first 365 days following the end of pregnancy. A **pregnancy-related death**, is included within pregnancy-associated deaths but refers specifically to maternal deaths directly related to or aggravated by pregnancy or its management.¹

PREGNANCY ASSOCIATED DEATH

The death of a woman while pregnant or within 1 year of the end of pregnancy, regardless of the cause.

PREGNANCY RELATED DEATH

The death of a woman while pregnant or within 1 year of the end of a pregnancy –from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.

The National Center for Health Statistics and the World Health Organization define a 'maternal death' as death of a woman while pregnant or within the first 42 days following delivery, regardless of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, exclusive of any maternal death from accidental or incidental causes¹. This definition is used to calculate global maternal mortality rates.

These varying definitions can be a source of global debate and confusion. Throughout this report, we include deaths through one year of the end of pregnancy. In addition, generally we use the word 'maternal' to refer to women during pregnancy, childbirth and the postpartum period. Use of this broad definition ensures that causes leading to maternal death beyond 42 days postpartum are neither missed nor neglected.

Identification of Deaths & Record Abstraction

The MMRC utilizes a multi-step approach to identify maternal deaths. First, causes of death related to pregnancy receive an ICD-10 code on the death certificate. In 2013, a checkbox was added to the Mississippi Death certificate that identifies if a woman was pregnant at the time of death, pregnant within 42 days of the end of the pregnancy or pregnant from 42 days to 1 year following the end of pregnancy. In addition to using these indicators on the death certificate, all death certificates for women of reproductive age are searched for a matching birth certificate or fetal death certificate issued within one year prior to the date of death. Each identified death certificate is evaluated for possible errors including erroneous checkbox selection or omission. Maternal deaths that are determined to not be pregnancy-associated are excluded from review. After all pregnancy-associated deaths are identified, records pertinent to the pregnancy and maternal death are abstracted by a trained obstetric nurse or physician. Relevant records for review include prenatal records, hospital and emergency room records, coroner and autopsy reports, law enforcement reports, news reports and obituaries. Accidents and homicides are not reviewed by the MMRC, but general statistics are generated. Maternal suicides and drug overdoses are reviewed by the committee.

Review and Evaluation

In 2017 the Mississippi Legislature passed House Bill 494 establishing the state's Maternal Mortality Review Committee (MMRC). This legislation formalized the process of including medical record review as part of the analysis of all maternal deaths within Mississippi. In order to begin evaluating the most recent maternal deaths, the committee began its review work with 2016 deaths. For 2013-2015 matching birth and death certificates and available coroner reports were reviewed by the MMRC's leadership team; medical records, however, were not available to be reviewed for the 2013-2015 years.

The Mississippi Maternal Mortality Review Committee uses the CDC Maternal Mortality Review Committee Decision Form and procedures to guide its evaluation of all deaths at committee meetings.² For 2016 deaths, the expert panel sought to answer 4 specific questions during the review process:

- 1) What was the cause of death?
- 2) Was the death "pregnancy-related"?
- 3) Was there a chance for providers to alter the outcome or was the death not preventable?

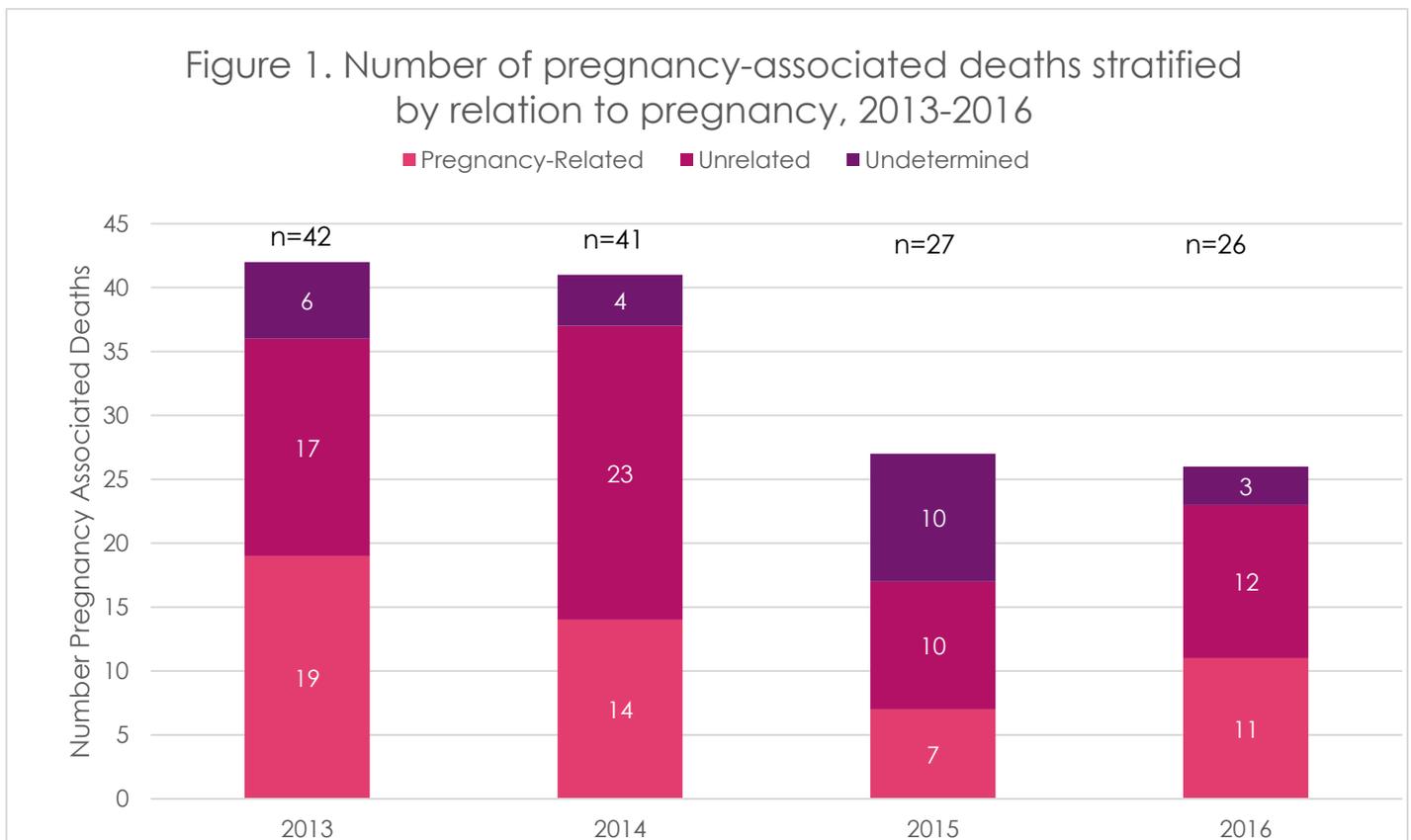
4) What recommendations from the MMRC should be advanced to prevent further maternal deaths?

Determining if a maternal death was pregnancy-related can present a challenge. Essentially, the committee asks, 'would she likely have died if she was never pregnant?' Some causes are by definition related to pregnancy (preeclampsia, obstetric hemorrhage). Others may be pregnancy related due to differences in medical care received because the woman was pregnant. Mental health-related deaths including drug overdoses and suicides may require an understanding of the woman's emotional state and thinking at the time of the death to know the relation to pregnancy or childbirth. If there was insufficient information to determine if a death was pregnancy-related, it is categorized by the MMRC as 'undetermined.' Statistics for the pregnancy-related mortality rates for Mississippi are generated both inclusive and exclusive of these undetermined deaths.

For the 2016 maternal deaths for which full medical records were available for review, the committee attempted to determine if the death was preventable and if there was some or a strong chance to alter the outcome. For the pregnancy-related deaths which are considered preventable, the committee reviews the contributing factors to the death (Appendix 2). Contributing factors might include patient, provider, health-care system, and community level factors. Recommendations are then generated for dissemination to providers and the public to foster a lessening of maternal morbidity and mortality within our state. The MMRC also provides general recommendations for each of the five categories of pregnancy-associated death.

Overview of Pregnancy Associated and Related Deaths

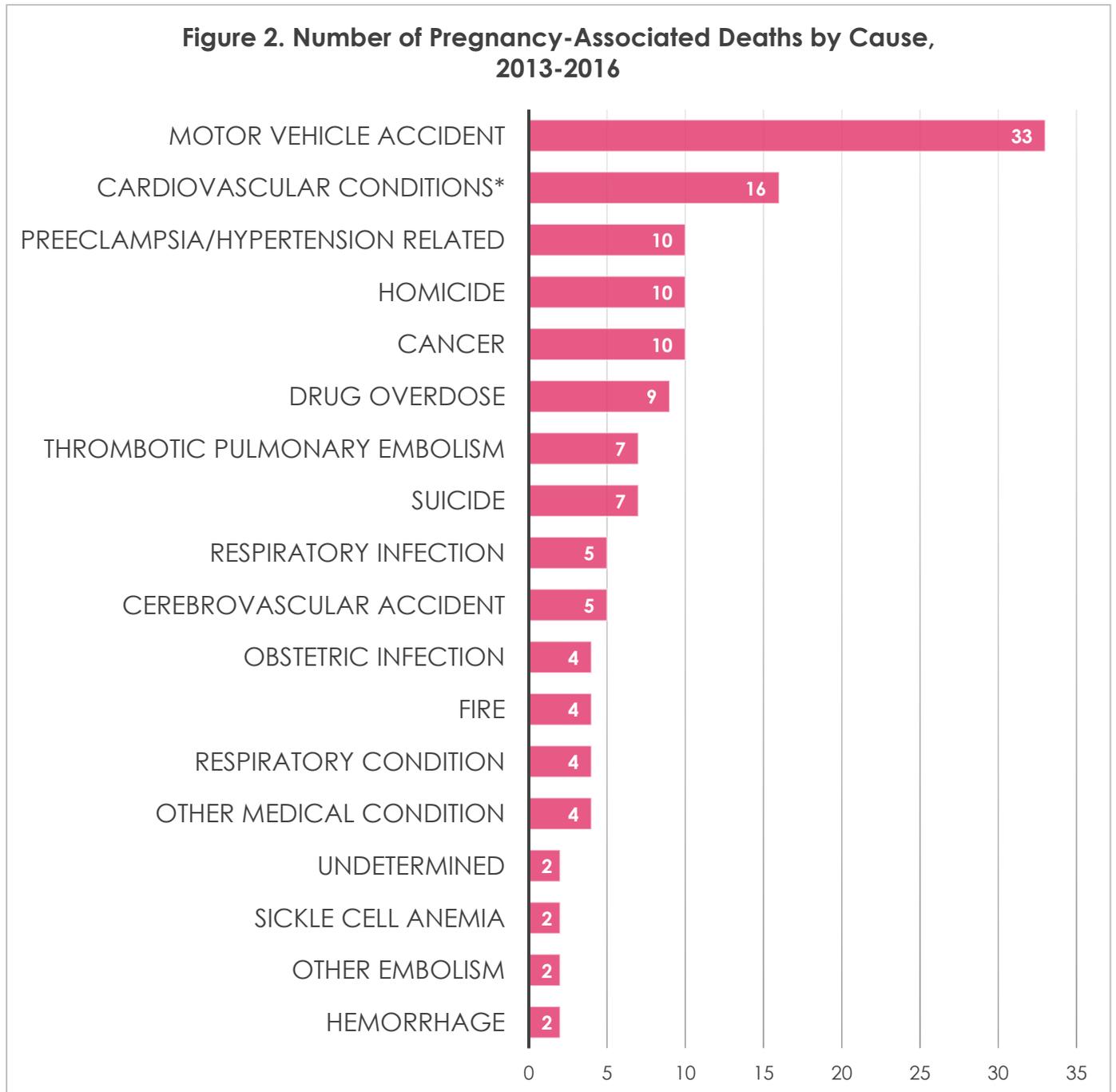
Between 2013 and 2016 there were 136 pregnancy-associated deaths of which 51 (37.5%) were pregnancy-related and 62 (45.5%) were likely unrelated directly to pregnancy. For the remaining 23 deaths, the specific relationship to pregnancy was undetermined. Over two-thirds of the undetermined deaths were suicides and drug overdoses. The year 2013 had the highest number and percentage of pregnancy-related deaths in the four-year period with 19 deaths (45%). 2015 had the lowest number at 7 deaths (25%). Over the four-year period there was a relative 42% reduction in the number of pregnancy-related deaths. **The pregnancy-related mortality ratio for the 2013-2016 period was 33.2 deaths per 100,000 live births.**



The maternal mortality rate, defined as the number of pregnancy-related deaths occurring during pregnancy or within 42 days of the end of the pregnancy for every 100,000 live births. Between 2013 and 2016 the maternal mortality rate was 20.8 deaths per 100,000 live births if the deaths with undetermined pregnancy relation were excluded.

Causes of Pregnancy-Associated Deaths

Figure 2. shows the causes of the 136 pregnancy-associated deaths in Mississippi between 2013 and 2016. The leading overall cause of maternal death was motor vehicle accidents, a cause unrelated to pregnancy itself. Among the likely pregnancy-related deaths, the leading causes included cardiovascular conditions, hypertension and preeclampsia-related conditions, thrombotic embolism, stroke (including ischemic and hemorrhagic) and infection.



*Including cardiomyopathy

Maternal Race

The pregnancy-related mortality ratio for Black women was nearly three times the rate for White women. There were insufficient numbers of deaths of women of other races and ethnicities to calculate a reliable rate or ratio for these groups.

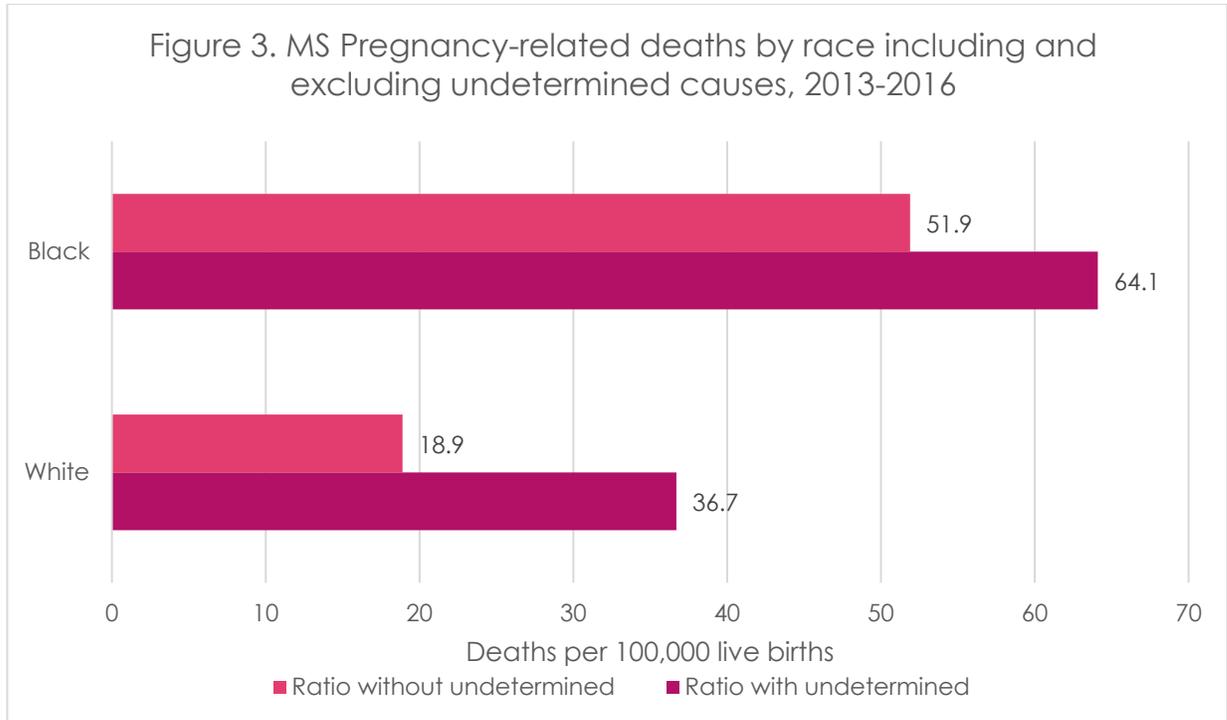
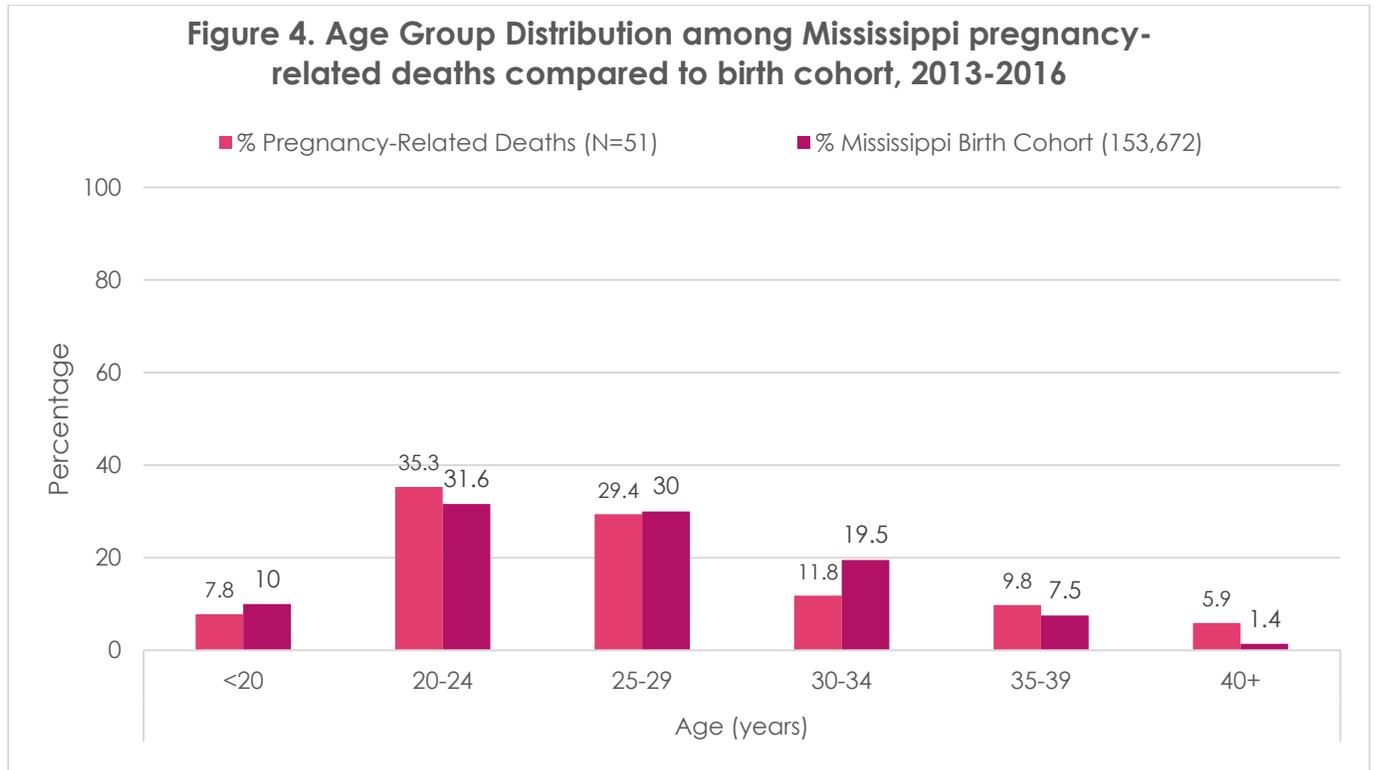


Figure 3 demonstrates the pregnancy-related mortality ratio for Mississippi both including deaths where the relation to pregnancy was undetermined and excluding those deaths. For Black women, the pregnancy-related mortality ratio ranged from 51.9 to 64.1 deaths per 100,000 live births. For White women, the ratio ranged from 18.9 to 36.7 deaths per 100,000 live births. In the U.S between 2011 and 2014 the pregnancy-related mortality ratio for Black women is reported at 40 deaths per 100,000 live births and for White women at 12.4 deaths per 100,000 live births.¹

Maternal Age

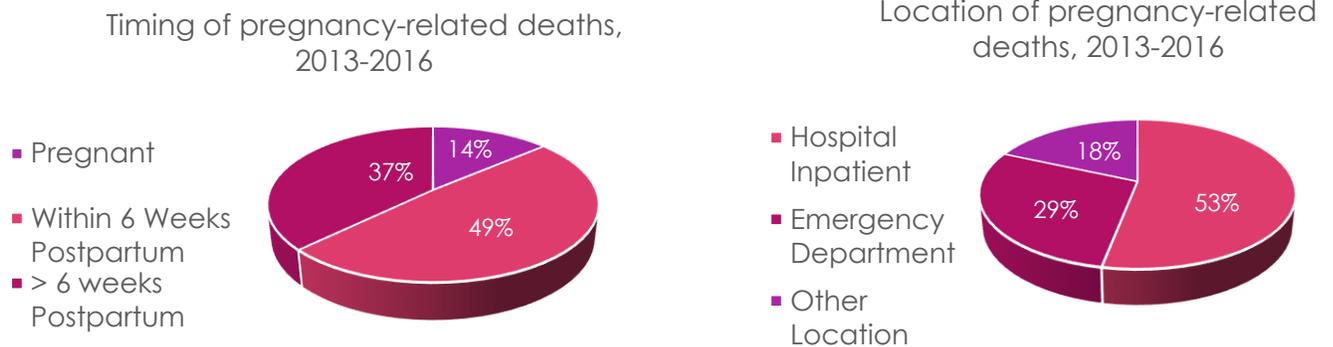
Thirty-five percent of pregnancy-related deaths occurred among women between 20 to 24 years of age. This age group also experienced the largest number of births in Mississippi (31.6%). The highest pregnancy-related mortality rate (deaths per 100,000 live births) occurs among women aged 35 to 39 (43.4 deaths per 100,000 live births) and over 40 (138.9 deaths per 100,000 live births).



Timing, Location and Pregnancy Outcome

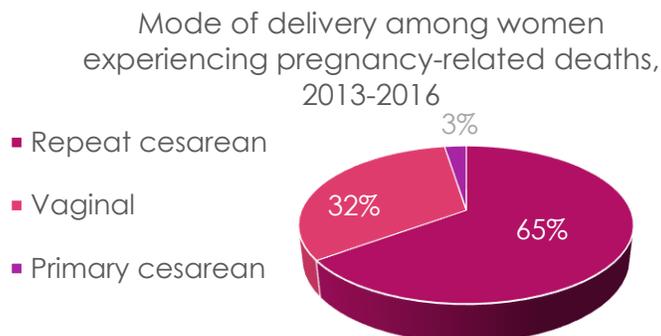
Of the 51 confirmed pregnancy-related deaths in Mississippi between 2013-2016, seven (14%) were pregnant at the time of death, 25 (49%) occurred during the first six weeks postpartum and 19 (37%) occurred greater than six weeks postpartum. For the 23 deaths for which a relationship to pregnancy was undetermined, two were within the first six weeks postpartum and the remaining 21 occurred greater than six weeks following the end of pregnancy.

Fifty-three percent of pregnancy-related deaths occurred among women admitted to hospitals, 29% were within hospital emergency departments and the remaining 18% were outside of the hospital setting at the time of death.



The pregnancy outcomes for the women who were not pregnant at the time of death included two of the preceding pregnancies ended in fetal demise over 20 weeks and the remainder resulted in live births. There were no maternal deaths which resulted from ectopic pregnancy or induced abortion.

Among the 44 women who were not pregnant at the time of death, 65% delivered by repeat cesarean section and 32% delivered by vaginal delivery.



Descriptions of Leading Causes of Pregnancy-Associated Deaths

The following section includes general descriptions of the leading causes of pregnancy-associated deaths, beginning with the leading pregnancy-related causes. Due to small numbers, rates are not calculated for most specific causes and numbers rather than percentages are provided. Descriptions of the age, race, and mode of delivery are provided. Information on body mass index (BMI) were missing from birth certificate data for nearly thirty percent of deaths, highlighting the need for improved data to better understand the contribution of obesity to maternal death. Throughout the case reviews, the racial disparities in outcomes are significant, with Black women experiencing a higher proportion of deaths for nearly every cause. These descriptions highlight the racial disparities. Included are several example scenarios that exemplify maternal deaths reviewed by the full committee. To protect the confidentiality of involved individuals, the details of actual cases are not used. These generated stories are intended to capture common themes identified and provide a better understanding of women's experiences than statistics alone.

Case Example- Cardiomyopathy

"Tara" was a 27-year old African-American mother of two with a medical history of chronic hypertension who delivered her third baby by cesarean section prematurely due to preeclampsia. During the pregnancy she experienced severely elevated blood pressures that initially improved after delivery.

At her postpartum visit Tara reported fatigue and ankle swelling and was prescribed iron and a new blood pressure medication. Her symptoms continued for another month when she experienced difficulty breathing. She was examined in a local emergency department and treated for asthma and acid reflux.

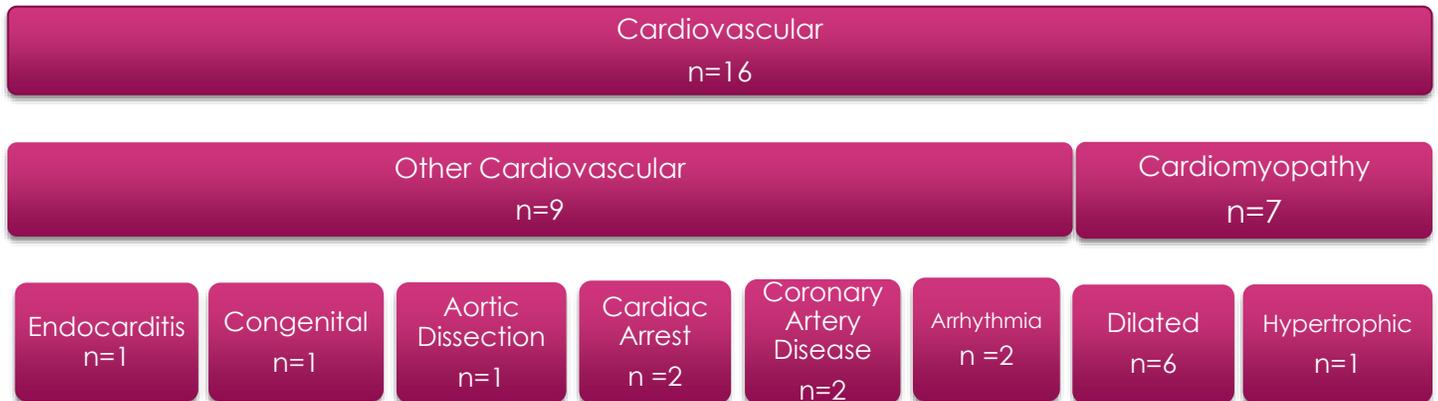
Two weeks later she died at home. An autopsy confirmed dilated cardiomyopathy.



Cardiovascular Conditions & Cardiomyopathy

There were **16** cardiovascular deaths from 2013 through 2016. **Seven** deaths were attributed to cardiomyopathy and **nine** deaths attributed to other cardiovascular conditions that were not specifically coded as hypertension-related (described above). The rate of cardiovascular deaths was **10.4 /100,000 live births**.

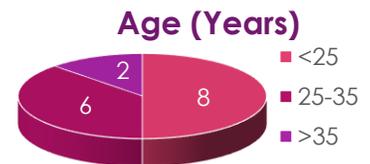
Causes of Cardiovascular Deaths



Timing: The majority of cardiac deaths occurred within the first six months following the end of pregnancy, ranging from 4 to 301 days, with a median of 49 days.



Maternal & Obstetric Characteristics: Half of cardiac deaths were among **women under 25** years of age and over two-thirds were obese.



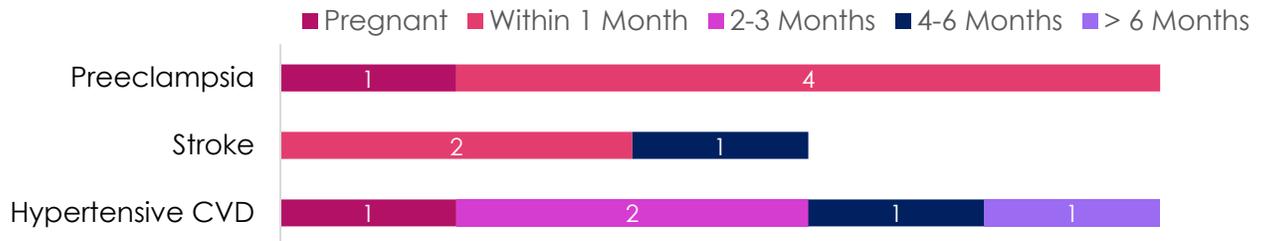
Race: From 2013 through 2016, nearly **80% of pregnancy-related cardiac deaths were among Black women**. The cardiac mortality rate for Black women was 21.4 deaths per 100,000 live births, nearly five times higher than the comparable rate of 4.7 deaths per 100,000 live births in White women.



Hypertension, Preeclampsia, Stroke

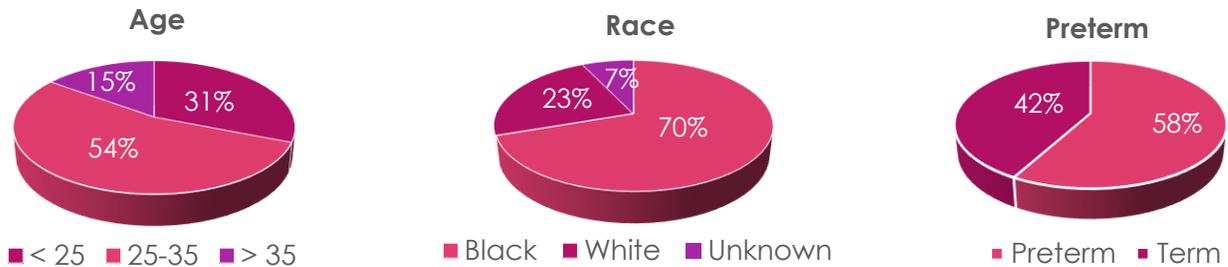
Between 2013 and 2016 there were **13** deaths associated with hypertension. **Five** were attributed to preeclampsia-eclampsia, **three** deaths were due to hemorrhagic stroke and **five** were attributed to hypertensive cardiovascular disease that was either concurrent with or following a form of pregnancy related hypertension. There were two ischemic strokes not related to hypertension and not included in the below statistics.

Timing: Overall, 61% occurred during pregnancy and the first 4 weeks postpartum.



Maternal & Obstetric Characteristics

Over half of the pregnancy-related deaths occurred among women between ages 25-35 years and over two-thirds of these deaths affected Black women. Eight of the thirteen women delivered preterm, demonstrating the elevated risk hypertension places on mother and baby.



Case Example- Eclampsia

“Roberta” was a 30-year-old African-American woman who delivered her first baby without any complications. She was discharged from the hospital two days after delivery but returned the next day with a severe headache. Her blood pressures were all over 160/ 90 mm Hg. She was admitted for observation and received medication for her headache and was started on oral blood pressure medication. While in the hospital her blood pressures remained elevated and her headache did not resolve. She experienced a seizure and then was unresponsive. Attempts at CPR were unsuccessful.

Thrombotic Pulmonary Embolism

Between 2013 and 2016 there were **7** pregnancy-related deaths attributed to thrombotic pulmonary embolism or blood clots within the lungs.

Timing

Six of seven (86%) thromboembolism deaths occurred during pregnancy or within first three months postpartum.



Maternal & Obstetric Characteristics

Most of thromboembolism deaths were among Black women under age 25. Over two-thirds were obese and six of the seven delivered by cesarean.



Case Example – Pulmonary Embolism

“Kasie” was a 24-year-old African-American female with a medical history of obesity and two prior cesarean deliveries. She delivered her third baby by repeat cesarean delivery that was complicated by a postpartum hemorrhage. She was readmitted 2 weeks following delivery for a surgical incision infection. She remained in the hospital for 3 days and was discharged home with home nursing for wound care. She was readmitted 2 days later with a fever and shortness of breath with suspected pneumonia. Her breathing status worsened and a code was called after she stopped breathing. Attempts at CPR were unsuccessful and she died. An autopsy demonstrated a large blood clot in the right lung and blood clots within the legs. While she received anticoagulation during the initial admission, this was not continued following the first hospitalization.

Infectious Causes

During the four years from 2013 to 2016 there were **four deaths due to obstetric infections** (uterine and/or cesarean incision) and **five deaths due to respiratory infections** including pneumonia (n=3) and influenza (n=2).

Timing

Three of the four obstetric infection deaths occurred within 7 days of delivery including one intrapartum death; the fourth death occurred within 6 weeks postpartum. Three of the four respiratory infection deaths were within 1 month postpartum and were likely pregnancy-related. Two deaths occurred greater than 6 months postpartum and were not likely pregnancy-related.



Maternal & Obstetric Characteristics

Three of the four obstetric infection deaths were among White women under 25 years of age. Among the five maternal losses related to respiratory infections, all women were between the age of 20-29 and three of the five were among Black women, two among White women.

Three of four obstetric infections were associated with cesarean delivery. Similarly, the respiratory infections occurring within one month of delivery (n=3) were among women who delivered by cesarean section.

Cancer

There were 10 pregnancy-associated deaths attributed to cancer during the 2013-2016 period. Three of the 10 were due to breast cancer; acute leukemia was second in frequency. On average maternal death due to cancer occurred 185 days postpartum, ranging from 51-346 days. 70% of the women were Black and 30% White, ranging in age from 22 years to 41 years of age (median age 34).

Psychosocial Causes

Between 2013 and 2016 there were **7 maternal deaths due to suicide**, **9 deaths due to accidental drug overdoses** and **10 deaths resulted from homicide**. Together these represent 19% of pregnancy-associated deaths. These deaths can be exceedingly difficult to directly attribute to pregnancy since a full understanding requires insight into the woman's psychological state and interpersonal relationships at the time surrounding her death. All deaths identified as suicides were completed through self-inflicted trauma. The scope of the committee review for 2016 was limited to suicide deaths and overdoses; full reviews of homicides were not performed.

Characteristics of pregnancy-associated deaths from suicide, drug overdose and homicide

	Suicide N=7	Drug Overdose N=9	Homicide N=10
Average Timing* (Range)	6 months (41-329 days)	5 months (4-265 days)	5 months (pregnant-213 days)
Average Age (Range)	23 years (20-28 years)	29 years (23-41 years)	26 years (19-32 years)
Percent Race (Highest percent)	71% White	66% White	60% Black

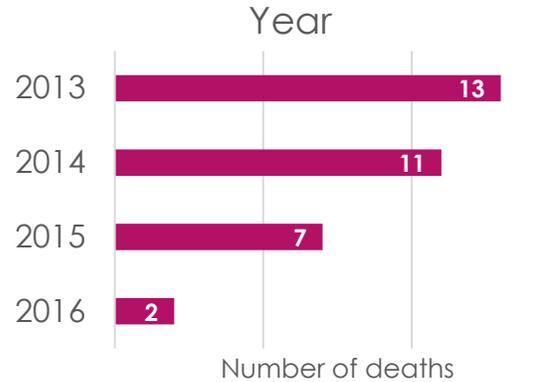
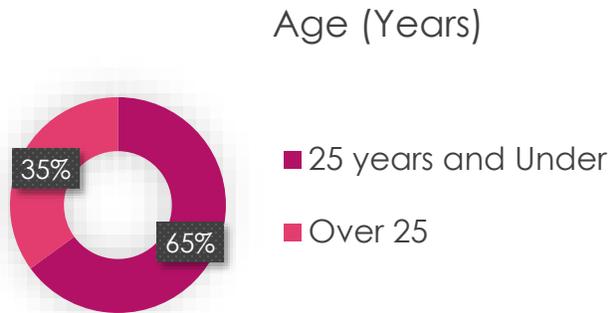
*during pregnancy or days postpartum

Case Example- Drug Overdose

"Priscilla" was a 22-year-old white female with a history of depression, sexual assault as a teen, tobacco use and narcotic drug use who was pregnant for the first time. She entered prenatal care at 13 weeks and reported daily prescription narcotic use but expressed a desire to quit. She was offered but declined a drug treatment program that was an hour from her home. She was briefly incarcerated for drug possession and missed the next prenatal visits. Three weeks after her release from jail she was found in a friend's apartment having died of an apparent overdose. Toxicology confirmed both methamphetamines and narcotics in her system.

Motor Vehicle Crashes

Motor vehicle crashes are not reviewed by the Mississippi Maternal Mortality Review Committee. They are often excluded from analyses of pregnancy-related deaths. Because the motor vehicle crashes were the leading cause of pregnancy-associated deaths between 2013 and 2016 (n=33), it is clearly an important area for public health awareness and potential initiatives to reduce their occurrence.



65% of Motor Vehicle Deaths were to women aged 25 and under

There has been an 85% decline in motor vehicle crash deaths since 2013



27% of the motor vehicle crash deaths in Mississippi from 2013-2016 affected women while pregnant. The remainder occurred on average 6 months following the end of the pregnancy ranging from 38 to 344 days postpartum. There were no significant racial disparities.

Opportunities for Prevention

Based upon the collection of information gathered and reviewed regarding maternal deaths in Mississippi, the Maternal Mortality Review Committee identified several recurrent themes contributing to maternal deaths, that if modified may prevent future deaths.

Contributing factors identified including:

- Delayed or insufficient response to critical clinical warning signs and patient complaints related to severe hypertension, respiratory distress, and heart failure.
- Missed opportunities to potentially prevent preeclampsia with low-dose aspirin in eligible women.
- Insufficient care coordination in the post-partum period, particularly for high-risk women needing follow up of both pregnancy-related and chronic medical conditions.
- Challenges with managing the risks of morbid obesity in the diagnosis and management of multiple medical problems, particularly respiratory complaints.
- Lack of coordinated hospital emergency protocols to identify and respond to threatened maternal cardiovascular collapse, respiratory distress, and sepsis.
- Insufficient access to insurance coverage for and utilization of injection medication to prevent blood clot development in high-risk women beyond the immediate postpartum period.
- Lack of adequate prenatal screening, treatment and access to mental health and substance use services for pregnant and postpartum women. Social stressors contributing to depression and substance use are rarely identified or addressed.
- Lack of medical insurance and medical care during the complete post-partum period through one year after the end of pregnancy, particularly for women with high-risk medical conditions.

Committee Recommendations

Recommendations for State Leaders:

- The majority of maternal deaths occurred in the postpartum period including 37% occurring after 6 weeks and involve women insured by state Medicaid. The committee supports **medical care and insurance coverage through the first year postpartum** to adequately address both chronic and pregnancy-related medical conditions.
- **Expand access to substance use and mental health services** for pregnant and postpartum women including community-based, telehealth and faith-based care.
- Support access to community-based **home-visitation and pregnancy support services** including doula services for pregnant and post-partum women.

Recommendations for Hospitals:

- Implement **standardized patient safety bundles** for common obstetric emergencies including severe hypertension, venous thromboembolism and hemorrhage.³
- Implement **maternal early warning criteria protocols** to prompt the appropriate evaluation and response to signs of distress.^{4,5}
- It is critical to **involve emergency departments** in obstetric emergency diagnosis and management plans, including non-obstetric facilities.
- Expand standardized education on the **timely treatment of severe hypertension**, ($\geq 160/110$ mm Hg) for all pregnant and postpartum women to include intravenous medication within 60 minutes of confirmed severe hypertension.⁶
- Integrate **simulation training** for maternal cardiopulmonary collapse and other rare but fatal emergencies that require coordinated multidisciplinary care.

Recommendations for Medical Providers:

- Prior to 16 weeks' gestation, all pregnant women should be screened for risk of preeclampsia and provided **low dose aspirin** in accordance with ACOG and the US Preventative Task force recommendations.^{6,8}
- **Diagnosis of pulmonary edema:** Providers should emergently evaluate women with respiratory complaints in the setting of hypertensive disorders of pregnancy to rule out life-threatening pulmonary edema. This includes appropriate imaging such as chest x-ray, echocardiogram or CT-scan of the chest. This is particularly important for obese women, in whom physical exam is limited.
- **Prevention of blood clots:** Women at significant risk for venous thromboembolism during pregnancy or the postpartum period should receive prophylactic or therapeutic anticoagulation as indicated. This may include standardized dosing based on maternal weight for up to 12 weeks postpartum in some patients.⁹
- **Early and ongoing comprehensive postpartum** care for all women can save lives. Screening for hypertension, cardiac disease and depression within the first 3 weeks postpartum is encouraged in accordance with ACOG recommendations.¹⁰
- All pregnant and postpartum women should be **screened for depression and substance use and provided with adequate treatment** and follow-up through 1 year. Providers should recognize the increased risk for pregnant and postpartum women to die by suicide than the non-pregnant peer population.
- Support and engage in medical education about social determinants of health, racial disparities and the influence of racism and bias in medical care and health outcomes.

Recommendations for Women, Families & Communities

- Know the **warning signs for obstetric complications** including severe hypertension, pulmonary embolism and postpartum depression and make a follow up plan with medical providers for where to go and what to do if a postpartum complication arises.
- Access **medical care before pregnancy** if possible, to address chronic medical conditions, family planning and improve general health.

Conclusion

The Mississippi Maternal Mortality Review Committee was established to comprehensively review pregnancy-associated deaths in Mississippi and, based on an assessment of the compiled data, to identify means and opportunities to reduce or eliminate future preventable maternal loss. Despite steady declines in the pregnancy-related mortality rate in Mississippi between 2013 and 2016, the current rate of approximately 29 deaths per 100,000 live births is more than twice the Healthy People 2020 goal of 11.4 deaths per 100,000 live births, and is a conservative estimate given the available data. The dramatic disparity in pregnancy-related mortality between Black and White women in Mississippi demands urgent attention and acknowledgement of how factors like social determinants of health and implicit bias can affect women's health and health care.

There are opportunities to improve pregnancy-related mortality in Mississippi at the individual, community, clinical, health-care systems, and health policy levels. Fundamental to these prevention strategies are ensuring that women are mentally and physically healthy prior to, during, and after pregnancy and that medical providers and systems are fully implementing evidence-based strategies in order to seek safer motherhood, reduce risk and respond optimally to medical emergencies for all women.

Resources

Data & Statistics

Centers for Disease Control & Prevention Pregnancy Mortality Surveillance System

www.cdc.gov

Maternal Mortality Review Committees

Centers for Disease Control and Prevention, Division of Reproductive Health's *Building US Capacity to Review and Prevent Maternal Deaths*

www.Reviewtoaction.org

Patient Safety Bundles & Toolkits

Council for Patient Safety in Women's Healthcare-Alliance for Innovation in Maternal Health

www.safehealthcareforeverywoman.org

Mississippi Perinatal Quality Collaborative www.mspqc.org

California Maternity Quality Care Collaborative www.cmqcc.org

ACOG District II Safe Motherhood Initiative <https://www.acog.org/About-ACOG/ACOG-Districts/District-II/Safe-Motherhood-Initiative?IsMobileSet=false>

Association of Women's Health, Obstetric & Neonatal Nurses www.ahonn.org

Patient Advocacy and Resources

My Birth Matters www.Mybirthmatters.org

Post-Birth Education Program <https://www.awhonn.org/page/POSTBIRTH>

National Birth Equity Collaborative www.birthequity.org

Preeclampsia Foundation www.preeclampsiafoundation.org

National Accreta Foundation <https://www.preventaccreta.org/>

References

1. Centers for Disease Control and Prevention. Pregnancy Mortality Surveillance System. <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pregnancy-mortality-surveillance-system.htm> accessed 1/14/2018
 2. The Centers for Disease Control and Prevention, Division of Reproductive Health, Maternal Mortality Review Information Application (MMRIA) MMRIA Committee Decisions Form, version 17, Published 2017. <http://www.reviewtoaction.org/content/maternal-mortality-review-committee-decisions-form>.
 3. Council for Patient Safety in Women's Health Care. Patient Safety Bundles, Getting Started. <https://safehealthcareforeverywoman.org/patient-safety-bundles/getting-started/> accessed 3/2019
 4. Mhyre JM, D'Oria R, Hameed AB, et al. The maternal early warning criteria: a proposal from the national partnership for maternal safety. *Obstet Gynecol.* 2014;124(4):782-786.
 5. Shields LE, Wiesner S, Klein C, Pelletreau B, Hedriana HL. Use of Maternal Early Warning Trigger tool reduces maternal morbidity. *Am J Obstet Gynecol.* 2016;214(4):527.e521-527.e526.,
 6. Emergent therapy for acute-onset, severe hypertension during pregnancy and the postpartum period. ACOG Committee Opinion No. 767. American College of Obstetricians and Gynecologists. *Obstet Gynecol* 2019;133:e174–80.
 7. Low-dose aspirin use during pregnancy. ACOG Committee Opinion No. 743. American College of Obstetricians and Gynecologists *Obstet Gynecol* 2018. 132: e44-52
 8. Henderson JT, Witlock EP, et al. Low-dose aspirin for prevention of morbidity and mortality from preeclampsia: a systematic evidence review for the U.S. Preventive Services Task Force. *Ann Intern Med* 2014; 160:695-703
 9. D'Alton, Mary E. et al. National Partnership for Maternal Safety: Consensus Bundle on Venous Thromboembolism. *Journal of Obstetric, Gynecologic & Neonatal Nursing* , Volume 45 , Issue 5 , 706 - 717
 10. Optimizing postpartum care. ACOG Committee Opinion No. 736. American College of Obstetricians and Gynecologists. *Obstet Gynecol* 2018;131:e140–50
-